

1997-98 ENGINE PERFORMANCE**Removal, Overhaul & Installation 2.2L****MODEL IDENTIFICATION**

Vehicle model is identified by fifth character of Vehicle Identification Number (VIN). VIN is stamped on metal pad on top of left end of instrument panel, near windshield.

INTRODUCTION

This article contains removal, overhaul and installation procedures (when given by manufacturer). If component removal and installation is primarily an unbolt and bolt-on procedure, only a torque specification may be furnished.

COMPUTERIZED ENGINE CONTROLS**POWERTRAIN CONTROL MODULE (PCM)**

NOTE: All vehicles are equipped with either an Engine Control Module (ECM), Powertrain Control Module (PCM) or Vehicle Control Module (VCM) for engine control. Unless specifically stated, references to PCM also apply to ECM and VCM equipped vehicles. Some vehicles equipped with an electronically-controlled transmission also use a Transmission Control Module (TCM) for transmission control.

CAUTION: Electronic components used in control systems are designed to carry very low voltages. As little as a 30-volt charge created by static electricity can cause a total or degrading failure in PCM or other electronic components containing integrated circuits. Before servicing PCM, technician must ground himself and work area to discharge static electricity. **DO NOT** remove part from packaging until ready to install. Ground any static-proof package before opening. **DO NOT** touch electrical terminals of components unless properly grounded. **DO NOT** lay electrical components on car seat, carpeting or dashboard. Use electrostatic protection mat and ground strap whenever possible.

NOTE: Before replacing PCM, carefully inspect all wiring and control components. Failure to test for short circuits may result in repeated PCM failure due to shorts and Quad-Driver failure. To prevent internal damage to PCM, ensure ignition switch is in OFF position when connecting or disconnecting PCM connectors or any electrical components.

NOTE: If the diagnostic procedures call for the PCM to be replaced, the PCM should be checked first to see if it is the correct part. DTC P0601 indicates the EEPROM

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programming has malfunctioned. When DTC P0601 is obtained, re-program the EEPROM.

Removal

PCM is located in right corner of engine compartment. Ensure ignition switch is in OFF position. The ignition should be OFF for at least 10 seconds before disconnecting power to the PCM so the IAC valve has time to move to the engine OFF position. Disconnect negative battery cable. Move the PCM retention bar and retainer away from the PCM. Unplug harness connectors from PCM. Remove PCM from vehicle.

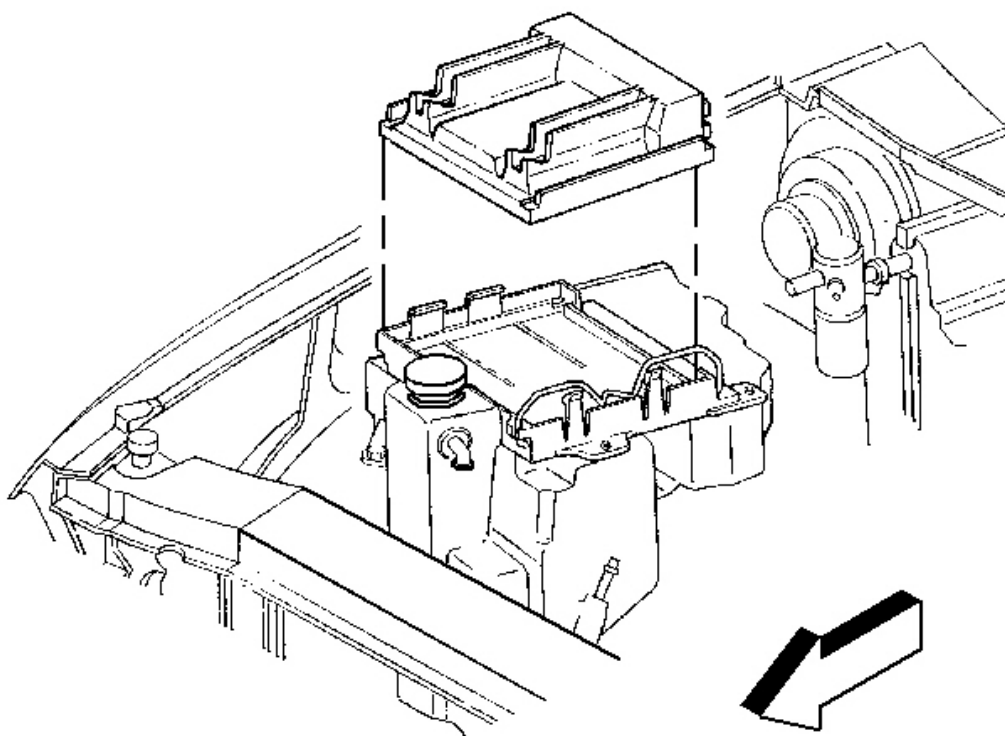


Fig. 1: Locating PCM Retainer And PCM
Courtesy of GENERAL MOTORS CORP.

NOTE: After installation of a NEW PCM, Malfunction Indicator Light (MIL) will remain on until PCM is programmed.

Installation

Install PCM into vehicle. Connect harness connectors to PCM. Reconnect negative battery cable. Slide the PCM

retainer into the PCM bracket slots. If NEW PCM has been installed, PCM MUST BE programmed and the crankshaft position system variation procedure must be performed.. For PCM programming, See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION. For crankshaft position system variation learn, see **Crankshaft Position System Variation Learn**.

ELECTRICALLY ERASABLE PROGRAMMABLE READ-ONLY MEMORY (EEPROM)

EEPROM is a permanent memory that is part of PCM. EEPROM cannot be replaced. EEPROM contains program and calibration information that PCM uses to control powertrain. If PCM is replaced, ensure that NEW PCM software/calibration is correct and most recent version for vehicle. EEPROM must be programmed when NEW PCM is installed. Program EEPROM using latest software for that specific vehicle. See COMPUTER RELEARN PROCEDURES article in GENERAL INFORMATION.

IGNITION SYSTEM

KNOCK SENSOR (KS) MODULE

NOTE: Knock sensor module is an integral part of PCM.

CAMSHAFT POSITION (CMP) SENSOR

Removal & Installation

On engines with distributorless ignition, CMP sensor is located in the engine block adjacent to cam. See **Fig. 2**.

CAUTION: To avoid any vehicle damage, serious personal injury or death when major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.

1. Raise the vehicle.
2. Remove the RH tire assembly.
3. Remove the Camshaft Position (CMP) sensor electrical connector.
4. Remove the CMP sensor
5. Install the Camshaft Position (CMP) sensor. Tighten the CMP sensor bolt to 10 Nm (7.5 lb in).
6. To complete installation, reverse removal procedure.

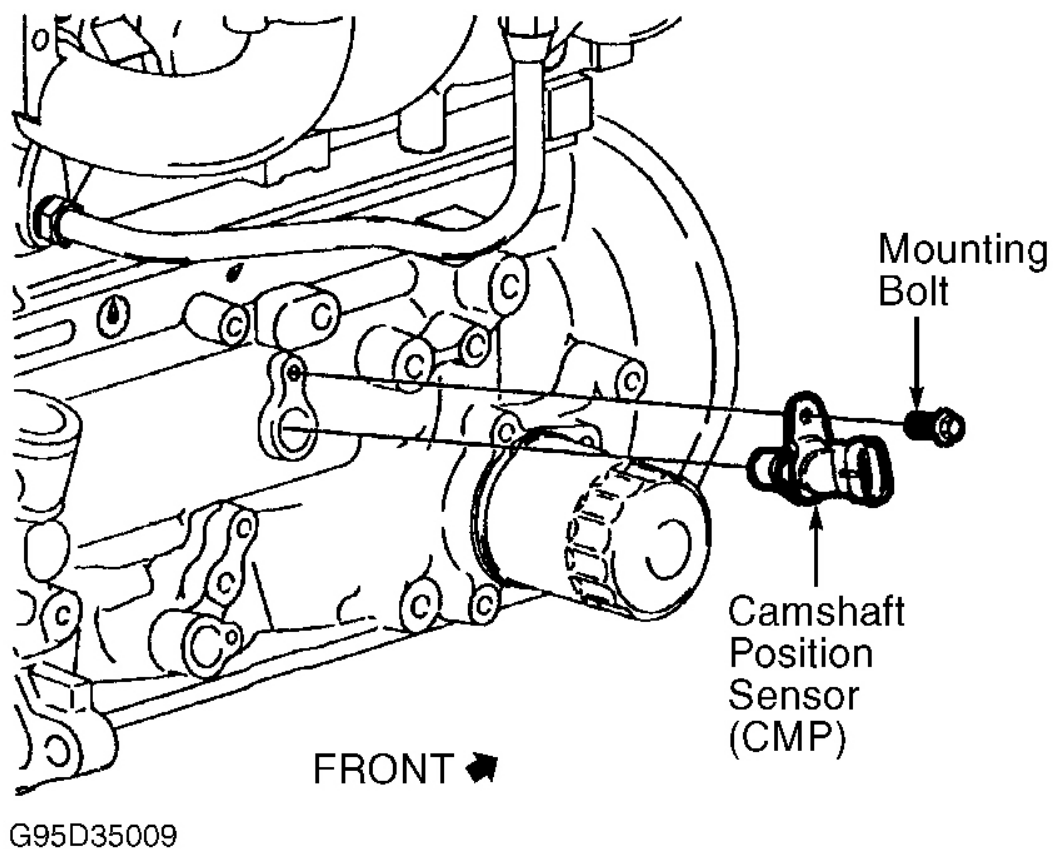


Fig. 2: Locating CMP Sensor

Courtesy of GENERAL MOTORS CORP.

CRANKSHAFT POSITION (CKP) SENSOR

Removal & Installation (24X Sensor)

Disconnect CKP sensor harness connector. Remove CKP sensor retaining bolt. Remove CKP sensor. See **Fig. 3**. To install, reverse removal procedure.

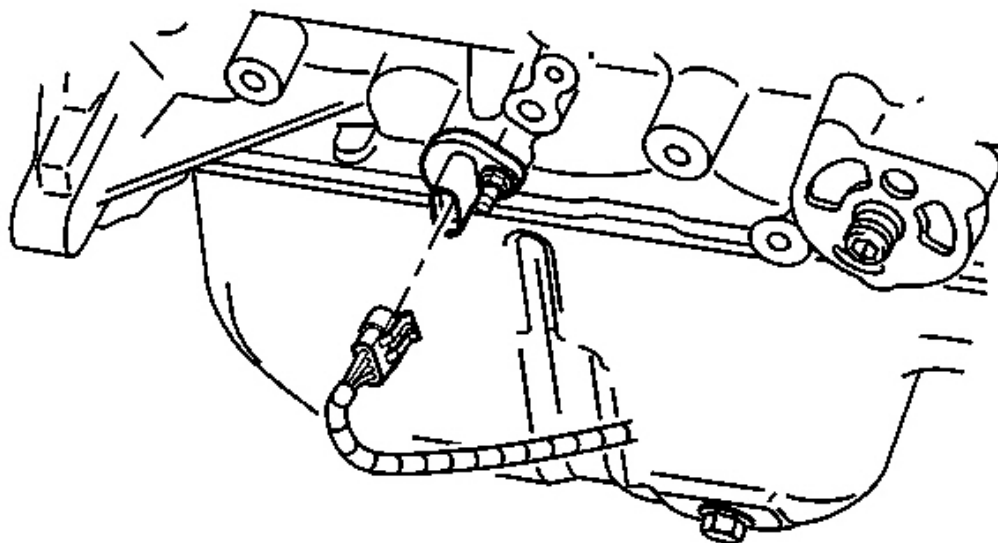


Fig. 3: Locating CKP Sensor
Courtesy of GENERAL MOTORS CORP.

Crankshaft Position System Variation Learn

IMPORTANT: A Crankshaft Position System Variation Learning Procedure must be performed any time a change is made to the crankshaft sensor to crankshaft relationship. Changing the crank sensor to crankshaft relationship will not allow the PCM to detect misfire at all speeds and loads accurately. Resulting in a possible false misfire DTC being set.

Removing a part for inspection and then reinstalling the same part is considered a disturbance. A false DTC P0300 could be set if this procedure is not performed. The learn procedure is required after the following service procedures have been performed, regardless of whether or not DTC P1336 is set:

- PCM replacement.
- Engine replacement.
- Crankshaft replacement.
- Crankshaft position sensor replacement.
- Any engine repair(s) which disturbs the crankshaft/harmonic balancer to the crankshaft position sensor relationship

CAUTION: Before performing the Crankshaft Position System Variation Learning

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Procedure always set the vehicle parking brake and block the drive wheels in order to prevent personal injury. Release the throttle immediately when the engine starts to decelerate in order to eliminate over revving the engine. Once the learn procedure is completed, the control module will return engine control to the operator and the engine will respond to the throttle position.

IMPORTANT: The battery must be fully charged and in good condition. The scan tool connection at the DLC is clean and tight before starting the Crankshaft Position System Variation Learning Procedure.

1. Close the hood.
2. Block the drive wheels and set the vehicle parking brake.
3. Put vehicle in Park or Neutral.
4. Turn all the accessories OFF.
5. Install a scan tool.
6. Run the engine until it is at normal operating temperature 85°C (185°F).
7. With the engine still running, enable the Crankshaft Position System Variation Learning Procedure with the scan tool.
8. Press and hold the brake pedal firmly and raise the engine speed to the specified value, **RELEASING** the throttle as soon as the engine cuts out.
9. Verify with the scan tool that the crankshaft variation has been learned.

Perform this procedure up to 10 times. If the PCM will not learn the variation, a DTC P1336 should be set. For 1997, refer to **DTC P1336 - CKP SYSTEM VARIATION NOT LEARNED** . For 1998, refer to **DTC P1336 - CKP SYSTEM VARIATION NOT LEARNED** .

IGNITION COIL AND IGNITION COIL MODULE REPLACEMENT

Removal Procedure

1. Remove the spark plug wires from the ignition control module assembly. The ignition coils and the spark plug wires are numbered in order to aid assembly.

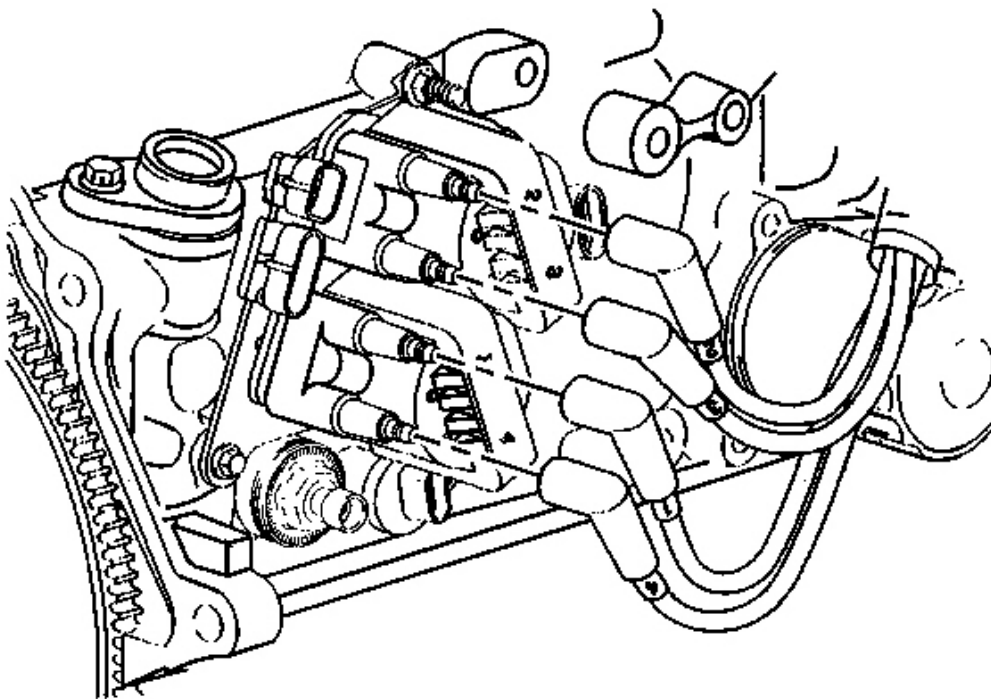


Fig. 4: Removing/Installing Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the electrical connector and the vacuum hoses from the purge solenoid valve

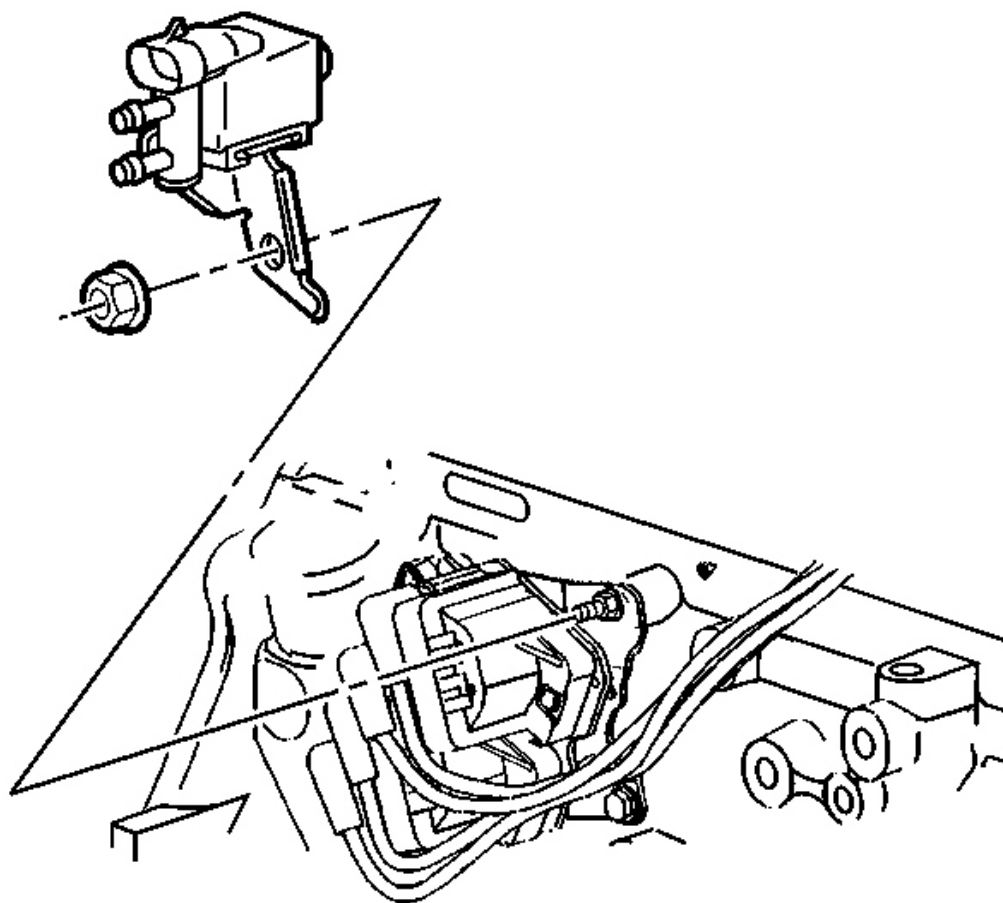


Fig. 5: Removing/Installing Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

3. Remove the nut and the purge solenoid valve.
4. Remove the two bolts and one stud retaining the ignition control module assembly.

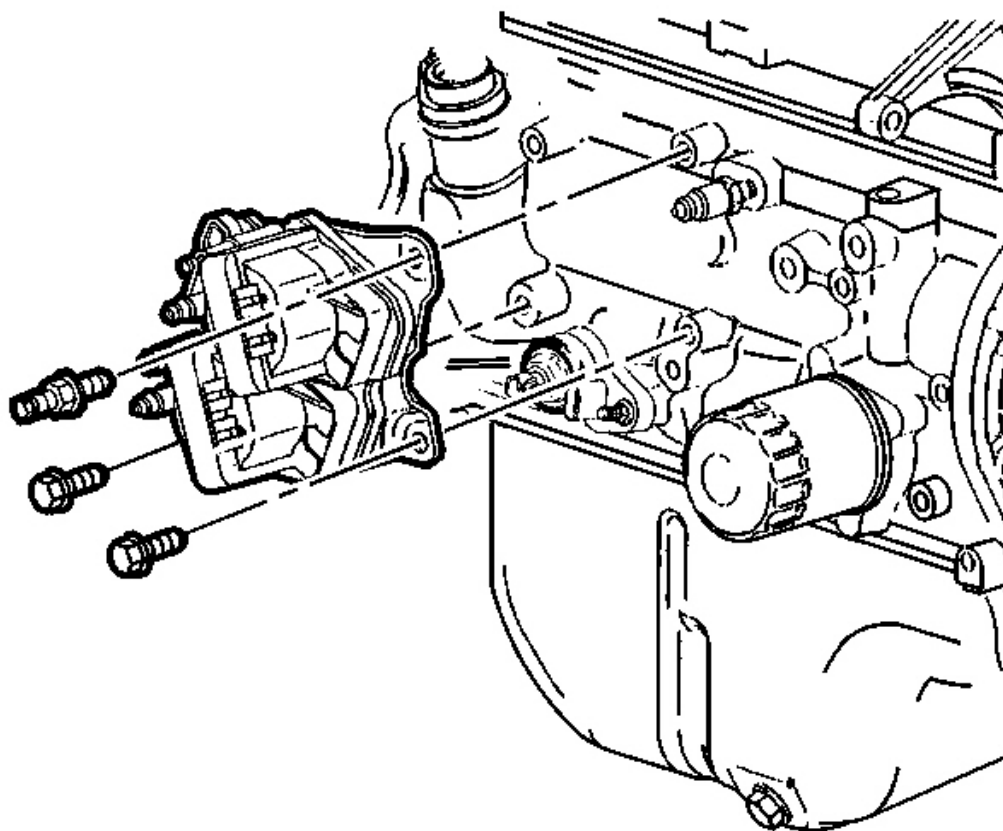


Fig. 6: Removing/Installing Ignition Control Module Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the ignition control module assembly

Installation Procedure

1. Install the ignition control module assembly to the engine with one bolt.

NOTE: Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or fasteners requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to

parts and systems.

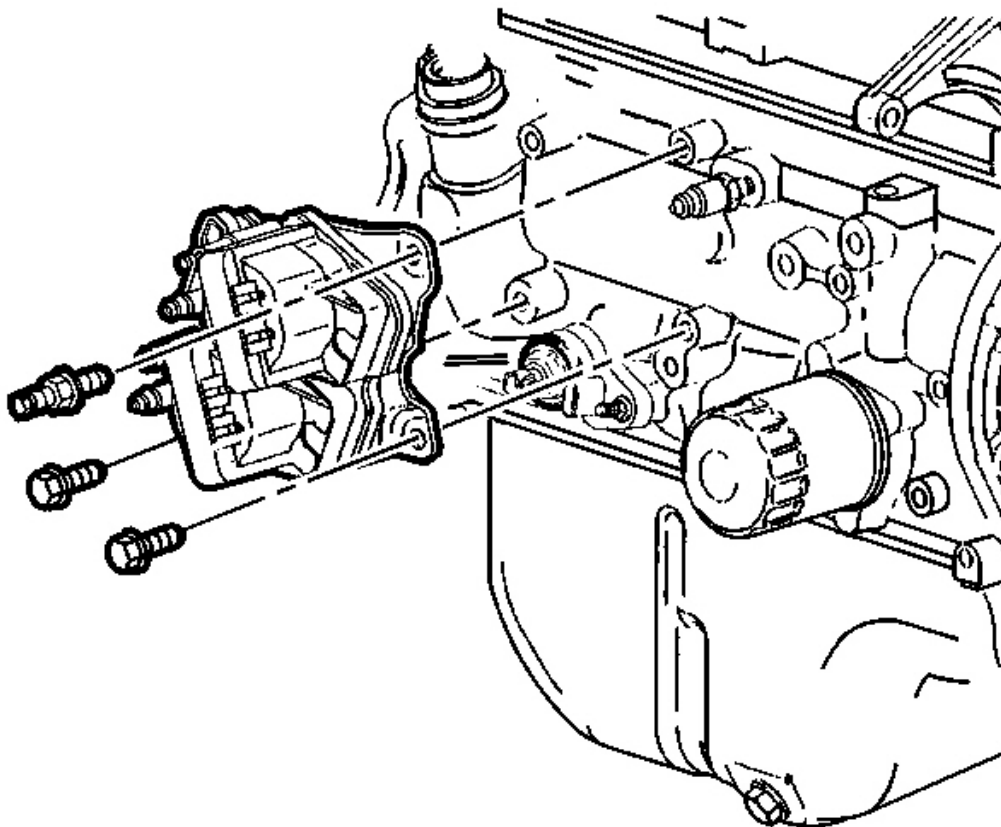


Fig. 7: Removing/Installing Ignition Control Module Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the remaining bolt and the stud. Tighten the bolts and the stud to 27 Nm (20 lb ft).

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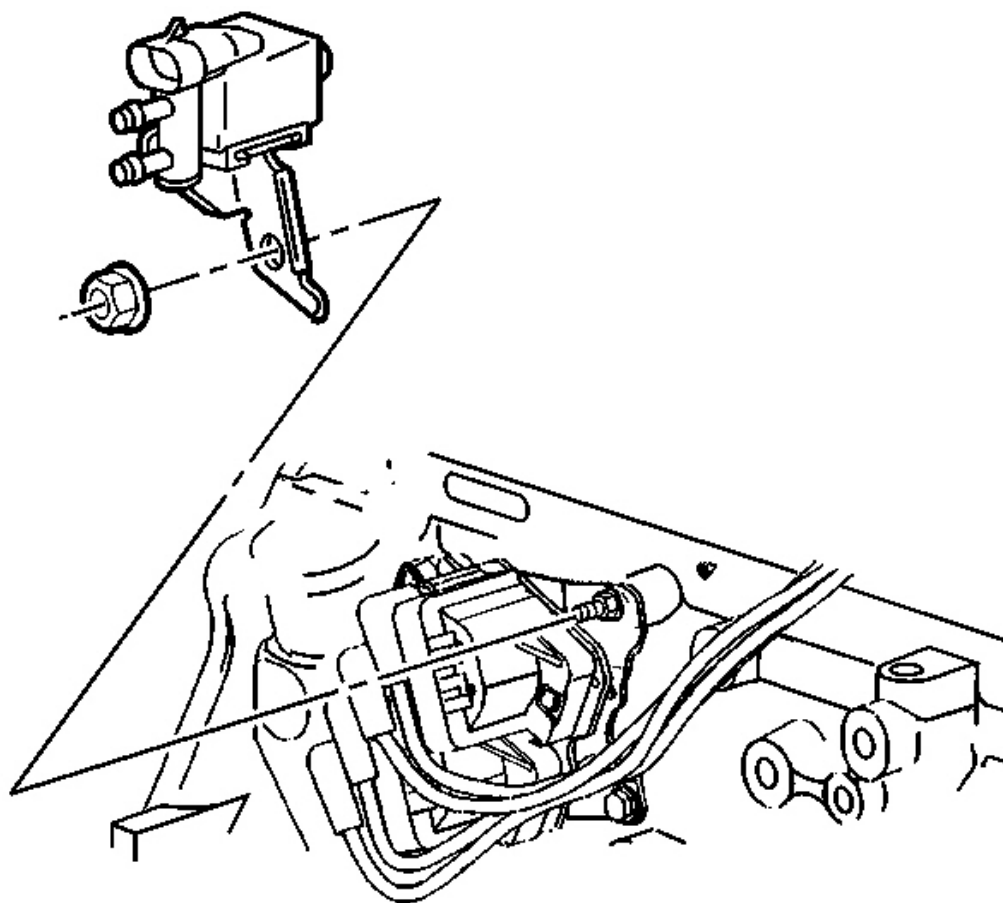


Fig. 8: Removing/Installing Purge Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

3. Install the purge solenoid valve and the nut. Tighten the nut to 27 Nm (20 lb ft).
4. Connect the electrical connector and the vacuum hoses to the purge solenoid valve.

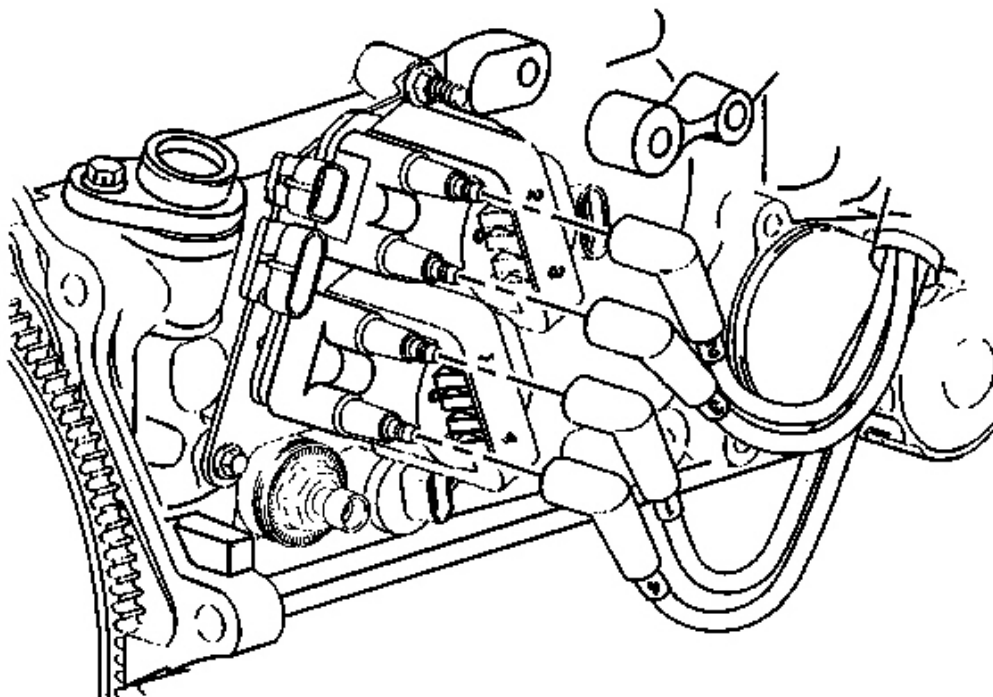


Fig. 9: Removing/Installing Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

5. Install the spark plug wires to the ignition control module assembly. The ignition coils and the spark plug wires are numbered in order to aid assembly.

KNOCK SENSOR (KS)

NOTE: Cooling system may need draining prior to removing knock sensor.

Removal & Installation

CAUTION: Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position, and all electrical loads must be OFF before servicing any electrical component. Disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the vehicle or its components

Knock sensor is located on side of engine block. See **Fig. 10**. Disconnect negative battery cable. Raise vehicle.

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Disconnect wiring harness connector from knock sensor. Remove knock sensor. To install, reverse removal procedure. Install sealant to sensor threads prior to installation. Tighten knock sensor to 14 ft. lbs. (19 N.m). Install harness connector. Lower vehicle. reconnect negative battery cable.

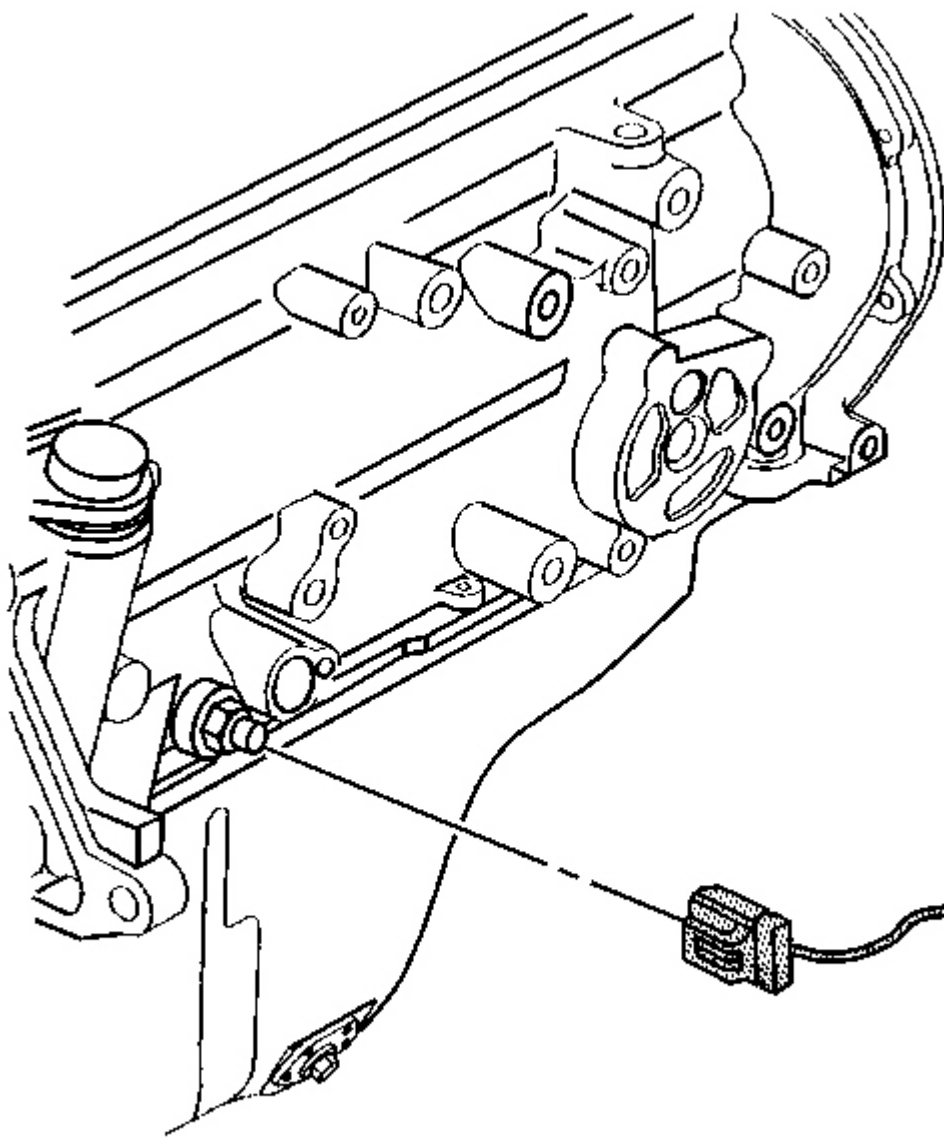


Fig. 10: Locating Knock Sensor

Courtesy of GENERAL MOTORS CORP.

FUEL SYSTEM

FUEL SYSTEM PRESSURE RELIEF

1. Disconnect negative battery cable. Loosen fuel filler cap to relieve fuel tank pressure. Install Fuel Pressure Gauge (J-34730-1) to fuel pressure connection.
2. Wrap shop towel around pressure connection when installing fuel pressure gauge to absorb fuel leakage. Place gauge bleed hose into suitable container. Open bleed valve to bleed fuel pressure.

FUEL PUMP

NOTE: When installing sending unit, **DO NOT** fold or twist strainer. This will restrict fuel flow.

Removal & Installation

1. Relieve fuel system pressure. See **FUEL SYSTEM PRESSURE RELIEF** under FUEL SYSTEM. Disconnect negative battery cable. Raise vehicle and remove fuel tank. Using Sending Unit Remover (J-36608 or J-24187), remove sending unit and pump by turning cam lock counterclockwise.
2. Remove fuel pump from sending unit by pulling pump up into attaching hose while pulling outward from the bottom support. **DO NOT** damage rubber insulator or strainer. To install, reverse removal procedure.

FUEL RAIL & INJECTORS

Removal

1. Relieve fuel pressure. See **FUEL SYSTEM PRESSURE RELIEF** under FUEL SYSTEM. Disconnect negative battery cable. Label fuel injector connectors for installation reference.
2. Disconnect fuel injector harness connectors. Disconnect fuel feed line at fuel rail. Disconnect fuel return line at pressure regulator. Remove fuel pressure regulator. Remove fuel rail retaining bolts. Remove fuel rail and injectors as an assembly. Disassemble as necessary.

Installation

To install, reverse removal procedure. Replace and lubricate injector "O" rings with clean engine oil. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**.

IDLE AIR CONTROL (IAC) VALVE

Removal

Disconnect IAC valve harness connector. Remove IAC valve retaining screws and remove IAC valve and "O" ring from throttle body.

CAUTION: DO NOT manually extend or retract pintle if IAC valve has been in service. Damage to worm gear will result.

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NOTE: Before installation, clean "O" ring sealing surface, pintle seat and air passage. If air passage has heavy deposits, remove throttle body for complete cleaning.

Installation

1. Inspect "O" ring for damage. Replace if necessary. If reusing IAC valve, DO NOT push or pull on pintle. Threads on worm gear will be damaged.
2. If replacing IAC valve, measure distance between tip of new IAC valve pintle and mounting flange. Distance should not exceed 1 1/8" (28 mm). If distance is more than specified, use finger pressure to slowly retract pintle. Lubricate "O" ring with clean engine oil.
3. Apply thread locking compound (Loctite 262) to IAC valve retaining screw threads. Install IAC valve to throttle body. Tighten IAC valve retaining screws to 27 INCH lbs. (3 N.m). Connect IAC valve harness connector.
4. To reset IAC valve pintle position, turn ignition on for 5 seconds. Turn ignition off for 10 seconds. Start engine and check for proper idle operation. Repeat IAC valve resetting procedure if proper idle operation cannot be obtained.
5. Start engine and allow it to reach normal operating temperature. Drive vehicle. It may be necessary to reset idle speed. To reset, disconnect negative battery cable for 10 seconds and reconnect. Cycle ignition on with engine off for 5 seconds. Turn ignition off for 10 seconds and restart vehicle. Proper idle will be initialized.

THROTTLE BODY

Removal & Installation

1. Disconnect negative battery cable. Remove air cleaner resonator from throttle body. Disconnect IAC and TP sensor harness connectors. Disconnect vacuum hose from throttle body.
2. Disconnect control cables from throttle body. Remove accelerator cable bracket. Remove throttle body attaching bolts. Remove throttle body and gasket. To install, reverse removal procedure.

THROTTLE POSITION (TP) SENSOR

Removal & Installation

1. Remove air cleaner assembly (if necessary). Disconnect harness connector from TP sensor. Remove attaching screws, lock washers, retainers, and TP sensor.
2. To install, reverse removal procedure. Adjust TP sensor to specification. See ADJUSTMENTS - 2.2L article. When replacing a TP sensor, ensure correct part number is used. Use Loctite on TP sensor attaching screws.

OXYGEN SENSOR

CAUTION: Oxygen sensor is equipped with a permanent pigtail which must be protected to prevent damage when removing sensor.

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Removal

1. Oxygen sensor is mounted in the exhaust pipe below exhaust manifold. Ensure sensor is free of contaminants. DO NOT use cleaning solvents of any type. Sensor may be difficult to remove when engine temperature is less than 120°F (48°C). Excessive removal force may damage threads in exhaust manifold or pipe.
2. Disconnect negative battery cable. Disconnect harness connector from oxygen sensor. Carefully remove oxygen sensor from exhaust pipe.

CAUTION: Correct torque of oxygen sensor is critical to prevent crushing glass beads in graphite anti-seize compound. Crushing glass beads will cause sensor to seize in exhaust manifold. This may require replacement of exhaust manifold upon next removal.

Installation

1. Whenever oxygen sensor is removed, coat threads with anti-seize compound before reinstalling. New oxygen sensors already have this compound applied to threads.
2. Install oxygen sensor in exhaust pipe and tighten sensor to 30 ft. lbs. (41 N.m). Reconnect harness connector to oxygen sensor. Reconnect negative battery cable.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
ECT Sensor	17 (23)
EGR Valve	22 (30)
Fuel Line Nut	20 (27)
Fuel Rail Retaining Bolts	18 (24)
Fuel Tank Strap Nuts	33 (45)
Knock Sensor	14 (19)
Oxygen Sensor	30 (41)
Throttle Body-To-Manifold Bolt	(1)
INCH Lbs. (N.m)	
Crankshaft Position Sensor Bolt	71 (8)
Idle Air Control Valve Screws	27 (2)
TP Sensor Bolt	27 (2)
(1) Tighten bolts to 89 INCH lbs. (10 N.m).	
(2) Tighten bolts to 11 ft. lbs. (15 N.m).	